

University of Groningen

Exploring rural digital hubs and their possible contribution to communities in Europe

Rundel, Christina; Salemink, Koen; Strijker, Dirk

Published in:
The Journal of Rural and Community Development

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2020

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Rundel, C., Salemink, K., & Strijker, D. (2020). Exploring rural digital hubs and their possible contribution to communities in Europe. *The Journal of Rural and Community Development*, 15(3), 21-44.

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Journal of Rural and Community Development

Exploring Rural Digital Hubs and Their Possible Contribution to Communities in Europe

Authors: Christina Theresia Rundel, Koen Salemink, & Dirk Strijker

Citation:

Rundel, C. T., Salemink, K., & Strijker, D. (2020). Exploring rural digital hubs and their possible contribution to communities in Europe. *The Journal of Rural and Community Development*, 15(3), 21–44.

Publisher:

Rural Development Institute, Brandon University.

Editor:

Dr. Doug Ramsey

Open Access Policy:

This journal provides open access to all of its content on the principle that making research freely available to the public supports a greater global exchange of knowledge. Such access is associated with increased readership and increased citation of an author's work.



**BRANDON
UNIVERSITY**
Founded 1899



Exploring Rural Digital Hubs and Their Possible Contribution to Communities in Europe

Christina Theresia Rundel

University of Groningen
Groningen, Netherlands
c.t.rundel@rug.nl

Koen Salemink

University of Groningen
Groningen, Netherlands
k.salemink@rug.nl

Dirk Strijker

University of Groningen
Groningen, Netherlands
d.strijker@rug.nl

Abstract

This article offers a conceptualization of rural digital hubs and outlines the variations among them. Using content analysis applied to websites and results from a survey, we draw a clearer picture of rural digital hub designs in the European context and how these relate to their socio-economic context. To explore their possible wider impact on rural communities, we apply the concept of community resilience. The study finds that there are various rural digital hub subtypes targeting businesses, community members, or both. There is a tendency to diversify such places or even to combine several subtypes, and we argue that this is a necessity if the hub providers are to reach the number of users required to generate added value, especially in the rural context. We have also found that rural digital hubs tend to address businesses and that it is expected that these places can to an extent contribute to community resilience. Furthermore, we narrow down the definition of a rural digital hub and suggest to make it place-dependent whether and how to implement new ones.

Keywords: Rural digital hubs, digital literacy, smart rural development, digital divide, community resilience

1.0 Introduction

Rural communities in Europe are dealing with diverse challenges. As Wilson (2010) indicated, many places in rural regions find themselves at a turning point, due to changes that these communities often have no direct influence over as these are driven by forces beyond the regional and even national levels. Among others, McManus et al. (2012) noted that many rural places in developed countries are facing rural decline caused by sectoral change, which in turn is leading to smaller numbers of jobs. In this context it is important to consider that areas facing population decline in particular struggle with the limited availability of financial resources (Raugze, Daly, & van Herwijnen 2017).

It was suggested that digital technologies can assist rural places to become better connected and thereby overcome the disadvantages of their remoteness (Townsend, Sathiaselalan, Fairhurst, & Wallace, 2013). Nevertheless, Next Generation Access is still lacking in many rural regions throughout Europe (Ashmore, 2015; Salemink & Strijker, 2018). This is not only an infrastructural problem, as also the skills and motivation required to make use of Next Generation Access are not always guaranteed in rural areas (European Network, for Rural Development [ENRD], 2017a; Lameijer, Mueller, & Hage 2017).

To tackle the connectivity, and especially the adoption problems, some places have implemented rural digital hubs (ENRD 2017a). Rural digital hubs have not yet received a great deal of attention in the academic literature, a clear conceptualization is still lacking and generally, adoption studies are less available compared to information and communication technology (ICT) provision studies (Salemink, Strijker, & Bosworth, 2017). However, considering the challenges that rural places are facing today, it is important to study this issue in greater depth.

The ENRD (European Network for Rural Development) expects that a rural digital hub will have broad benefits for local communities. Not only do they take into account the benefits associated with digitisation—for example, improving the digital literacy of local inhabitants and local businesses or providing fast broadband connections—but the ENRD also stated that rural digital hubs can strengthen the local community and attract new residents or businesses. Further, it was suggested that these improve conditions for economic activity, such as networking possibilities (ENRD, 2017b). Such possible benefits were also noted by Ashmore and Price (2019), and Roberts, Anderson, Skerratt, and Farrington (2017) mentioned ‘community technology hubs’ as possible training places for digital inclusion.

To assess the validity of these claims, we investigated the setup of rural digital hubs in several European countries. To determine their wider contribution, we decided to go a step further and conceptualize how these might contribute to overall community resilience, hoping to answer the following question:

What types of rural digital hubs exist and how do the initiators and operators of these different hubs expect them to foster overall community resilience?

To set this research into the policy context, we introduce here some European circumstances. For policies concerned with digital literacy in rural areas it is important to consider the Smart Village Initiative at European level. The EU described Smart Villages as places where existing and developing networks and services are supported by digitisation (Zavratnik, Kos, & Duh, 2018). Furthermore, the *A new skills agenda for Europe* communication deals with the topic of digital skills (European Commission, 2016a). It encourages countries within the EU to establish specific digital skills strategies (European Commission, 2016a, 2017) and offers a common concept which can be used as a guideline by European countries in creating their digital skills agendas. It identifies challenges for the following groups: (a) students, (b) specific groups of community members (e.g., older adults or people on a low income), (c) the labour force, and (d) IT professionals (European Commission, 2017). However, policies and recommendations in terms of the improvement of digital skills in rural areas remain unspecified. While in the introduced policies, the term ‘digital skills’ is used, we are instead speaking of digital literacy in this paper, since it depicts a wider concept.

The outline of the paper is as follows. Section 2 presents various rural digital hub types and our understanding and operationalization of community resilience. Section 3 introduces the various steps taken to approach the

appearances and influences of rural digital hubs, section 4 presents the content analysis and survey findings. Section 5 discusses our findings and provides an additional analytical layer. In section 6, we highlight our main conclusions and propose further research topics.

2.0 Conceptualization of Rural Digital Hubs Types

The term ‘hub’ is used widely and concerns various fields. Before defining it in relation to digitalisation, we will look at its general meaning. In urban studies, for example, it might refer to cities. Derudder, Conventz, Thierstein, and Witlox (2014) described ‘hub cities’ as interconnected and as ‘knowledge hubs’. Neal (2014) spoke of ‘hub cities’ as nodes and focal points of networks in an urban context. The economic advantage of such cities is stressed, with the city being described as a ‘hub of activities’ (Neal, 2014).

More generally speaking, a ‘hub’ may describe a geographical place (Ramirez, 2007). However, hubs are not necessarily physical entities: an e-hub stands for a business-to-business web market, which brings providers and customers together (Kaplan & Sawhney, 2000). Further, households likely host a hub. Since many homes are equipped with various ICT equipment nowadays, these can also be described as ‘infrastructural hubs’ (Hjorthol & Gripsrud, 2009). Thus, although the term is used in various contexts, it always describes a central point or place where the main action occurs.

A further essential topic associated with hubs is the flows and spokes, as the example of transport hubs suggests (Bowen, 2012). Concerning transport hubs, Pettit and Beresford (2009) introduced the transformation of ports from ‘gateways’ into ‘logistic hubs’ and the increasing focus on value addition. We argue that flows and value addition are important aspects of rural digital hubs. People coming to the hub can be regarded as flow, receiving additional services at the respective facility.

In the academic context, the term ‘rural digital hub’ itself has rarely been discussed. Instead, other terms have been used for various hub forms, most of which are not specifically applied in the context of rural areas. These will be introduced in the following subsections. The ENRD published a definition of rural digital hubs, which we have taken as a starting point for our review of the literature:

Rural digital hubs offer physical spaces with fast, reliable internet access that provide a whole range of business and community support services in rural areas. The activities offered by digital hubs depend both on whether their target is businesses, the community, or both and whether they provide space or also specific services to their target groups. Most digital hubs cannot be categorised within a single category of activity, but carry out a combination of these. (ENRD, 2017a)

Nevertheless, we think it is of importance to either verify, or maybe adapt, this definition depending on what kind of rural digital hubs exist and what their characteristics are. This can help policy makers to differentiate approaches, especially in the light of a European policy agenda increasingly focusing on digitalisation.

2.1 Categorization of Digital Hub Forms

2.1.1 Digital hubs focusing on businesses. We have identified several forms fulfilling the description of a rural digital hub focusing on businesses. One of

these is ‘rural enterprise hubs’. With their assistance, businesses shall be supported and new businesses developed. Almost all case studies of rural enterprise hubs by Cowie, Thompson, and Rowe (n.d.) offer broadband, fitting to the rural digital hub concept. Mostly these provide several services, for example, (a) shared amenity space, (b) office space, (c) support, and (d) networking opportunities.

While these spaces are not specifically assigned to rural areas, ‘co-working spaces’ can also be classified as one of the previously described enterprise hubs. According to Fuzi (2015), co-working spaces are designed for entrepreneurs to share with others. For example, these can aim at sharing technologies, exchanging information, seeking cooperation, or finding support. Various facilities may be offered and support in a variety of forms may be given. As one study from Finland suggested, co-working spaces can be further differentiated into subcategories such as ‘third places’ and ‘incubators’. Incubators are workspaces that are shared by a group of people aiming at the establishment of business activities while third places are used by the public at large. These usually offer other services, for example, a cafeteria (Kojo & Nenonen, 2016). Writing about co-working spaces in a rural Swiss area, Bürgin and Mayer (2020) mentioned that they were also declared as ‘mountain hubs’.

A similar term used by Buksh and Davidson (2013) is ‘digital work hubs’. These are presented as a combination of co-working and teleworking and as places which can assist regional agglomeration and reduce economic differences. Digital work hubs are largely designed for people normally commuting to work or working at home. A special form of enterprise hubs is ‘creative hubs’: These are defined as places primarily offering business support to creative small and medium-sized enterprises (SMEs) (Virani, 2015). Further specialised, ‘technology and innovation hubs’ can be a kind of co-working space for people working in the digital technology sector to collaborate there. Another name can be ‘tech hub’ or ‘ICT hub’. Various services can be offered, also incubation or community building can take place there (Jiménez & Zheng, 2018).

Further focused on digital technology, ‘Digital Innovation Hubs (DIHs)’ have digital hub already in the name. In a communication on policy measures, the European Commission explained that DIHs should provide access to the newest technological developments for all industrial sectors within Europe and promote innovation (European Commission, 2016b). As such, a DIH is defined as a place for businesses to make contact with the latest technological developments (European Innovation Partnership [EIP]-AGRI 2017), (European Network for Rural Development [ENRD], 2017c). One special variant of DIHs are those for agriculture. These shall help the farming sector to take advantage of digital developments by providing the necessary know-how and testing possibilities (EIP-AGRI 2017).

In conclusion, we can distinguish hubs focusing on business activities in general and some stressing the focus on technological–digital innovation, such as the DIHs and technology and innovation hubs. In the following chapters, we name these two types ‘enterprise hubs’ and ‘innovation hubs’. Innovation hubs can thereby, for example, include technology demonstrations. This means that we also label hubs focused on training businesses in new digital technologies as innovation hubs.

2.1.2 Digital hubs with community focus and combined forms. A Public Internet Access Point (PIAP) has its main focus on ICT accessibility and provision to the community. These are often provided in rural areas and aim at the most underprivileged (Arifoğlu, Afacan, & Er, 2011). There are many terms for a PIAP, such as (a) telecentre, (b) digital (community) centre, (c) community

technology or community multipurpose centre, and (d) telecottage (e.g., Hayden & Ball-Rokeach, 2007). PIAPs aim to decrease the digital divide (Arifoglu, Afacan, & Er, 2013) by providing hardware to gain access to the internet and other equipment such as printers. London, Pastor, Servon, Rosner, and Wallace (2010) also noted that the services offered by a community technology centre may be very broad. These can range from aiming at developing basic skills to providing advanced training. The European Telecommunications Standards Institute considered every public facility that offers internet access to be a PIAP. Internet or cyber cafes are other types of PIAP. These may be commercially or publicly provided and can be further differentiated concerning their services (Institute of European Telecommunications Standards, 2008). Examples of such services include library facilities, computer training and e-government services (Arifoğlu, Afacan, & Er, 2011). It was reported that these might be operated by NGOs and be established at locations already serving the community, such as a library or school, village hall, other government offices, or even rural internet cafes, and thus not only as a single-purpose facility (Arifoglu, Afacan, & Er, 2013; Lægran, 2002; Huggins & Izushi, 2002). That libraries can indeed be places to foster digital literacy, for example by offering learning events such as maker parties, was also noted by Nygren (2014). Libraries were described as crucial lifelong learning community hubs and can facilitate 21st-century skills learning.

Based on these literature findings, we distinguish places primarily offering internet access—‘PIAPs’—and ‘training hubs’—providing digital literacy training over a longer period. In this study, however, we exclude places offering WiFi to the public only from the PIAP definition.

Finally, the already introduced hub forms can exist in various combinations. Fab labs can especially be described as places targeting both the community in general and entrepreneurial activities. These can be defined as places reaching out to different stakeholders, providing manufacturing laboratories. Innovations among communities can be fostered, businesses can prototype and design there, and students can learn more about technology and designing (Stacey, 2014).

2.1.3 Categorization and further remarks. Based on the literature findings presented, we distinguish the following forms and subcategories of digital hubs which could also be found in rural areas (see Table 1). As previously described, a combination of types is possible.

Table 1. *Rural Digital Hub Types*

Type of hub	Rural digital hub for businesses	Rural digital hub for the community	Rural digital hub for businesses and the community
Subcategory	Enterprise hubs (co-working hubs etc.)	PIAPs (and similar terms)	Fab labs
	Innovation hubs	Training hubs	Combination of types
	Combination of subcategories	Combination of subcategories	

The existing literature presents various functions and issues associated with the different types of digital—including rural—hubs. Many studies looking at different types of hubs noted above indicated their function as a meeting and networking space (Capdevila, 2017; Clark, 2003; Kojo & Nenonen, 2016; London et al., 2010; EIP-AGRI, 2017; Willis, 2017). Several potential issues or problems faced by digital hubs were also considered by various studies; for example, the possible low usage rates (Arifoglu, Afacan, & Er, 2013; ENRD 2017a, 2017c; Huggins & Izushi 2002; EIP-AGRI 2017). Various other functions, advantages and issues were introduced in the literature, but we will not go into details here. Instead, we will explore them specifically in relation to the rural digital hubs analysed in this study. Nevertheless, the possible disadvantages mentioned in the literature are taken into consideration in our survey too.

2.2 Hubs and Community Resilience

The definition of resilience depends on the discipline it is applied to, and in this study, we refer to evolutionary resilience as described by Davoudi (2012). Since a system is constantly subject to changes, resilience can be seen as a process performed under change. Specifically, community resilience is the ability of communities to respond to changes. This can either mean that a community attempts to preserve a specific condition or that it actively strives for a change from the original condition (Davoudi, 2018; Folke, 2006). This spectrum of responses can be summarized as a ‘preparedness for transformation’, as Apostolopoulos, Newbery and Gkartzios (2019) described. In order to benefit from a current transformation, one should already have a vision of the alternative future. The vision of the new state of a system, however, differs among people. In turn this also means that there are always winners and losers in the process (Davoudi et al., 2012).

Roberts et al. (2017) emphasised that the use of digital technologies has thus far not been linked to resilience. While technological progress can contribute to the change of society, it can also contribute to the resilience of people (Roberts et al., 2017). Therefore, we also follow their definition of community resilience focusing on social and economic resilience and not so much on environmental resilience (Zwiers, Markantoni, & Strijker 2016), as the latter cannot be directly linked to digital development and hence to the topic of rural digital hubs. It is important to add that we understand community resilience not only as preparedness for abrupt change but also for gradual developments, here specifically referring to digitisation. Furthermore, in social systems, resilience can be influenced by interventions (Davoudi, 2012). Community resilience can for example be fostered by meeting places (Skerratt & Steiner, 2013), formal and informal learning possibilities (Glover, 2012), a diversified economy (Steiner & Atterton, 2014) and social participation possibilities (Steiner & Markantoni, 2014). A rural digital hub could contribute to all of these. Therefore, we make use of the community resilience concept in this study to explore in how far the hub operators expect these spaces to benefit the local community in broader terms.

3.0 Methodology

3.1 Research Approach

Overall, our approach consisted of three steps, following a mixed-methods strategy including desk research, a qualitative survey, and a content analysis of websites. By doing so, the findings from one method feed into the other (Frennert, Efring, & Östlund, 2013). The qualitative input thereby helps us to get hold of the hub contexts just as described by Fidel (2008).

First, our research involved a literature review to conceptualize rural digital hubs based on our initial definition. We created subcategories of digital hub types discussed, assuming that these can also exist in rural areas. As such, we searched for hubs focusing on ICT accessibility and digital literacy training. The target group of the hubs could be businesses, community members or both.

In determining whether the initiators expected more than the provision of internet access and the improvement of digital literacy from their rural digital hubs, we referred to the concept of community resilience, which can capture broader hopes for the respective rural areas. This concept was briefly introduced and explained to the survey participants.

On that basis, a survey for rural digital hubs providers was designed (McGuirk & O'Neill, 2005) to explore what kind of rural digital hubs exist and what benefits the initiators expect from them for the rural community. Partly, the survey consisted of open questions (see also Bryman, Becker, & Sempik, 2008) to better grasp for example the aim of the hub, the design, how challenges are approached or what other similar initiatives are to be found in the area. Some of these responses can be found as quotes in the results section. Altogether, the survey consisted of 33 questions and was set up using Qualtrics software. The definition and categories of rural digital hubs were then used for our follow-up search in which we identified the online presence of these digital hubs. Various combinations of primarily English search terms from our literature research were used, for example 'telecottage,' but also respective Dutch and German translations. This resulted in contacting 154 places who fulfilled our rural digital hub definition and ten regions participating in the Interreg project called CORA (Connecting Remote Areas) were approached since some of these had or were busy setting up a rural digital hub (European Union Interreg North Sea Region, n.d.). All these places were only added to the sample after controlling for their primarily rural location in Europe and excluding temporary digital literacy courses. With this sample size, we aim at providing an initial overview of different rural digital hub types existing. We stopped the sampling after a search term did not deliver any new hub results for several search engine pages.

Further, we conducted a content analysis of the web-based content of all hubs initially found. Kim and Kuljis (2010) described content analysis of web-based content as a method enabling adaptive data selection. Thereby, it is important to determine a suitable sample size. Terlouw and Denkers (2011) for example compared 67 websites for a quantitative content analysis. Categories can either be formed beforehand or during the analysis (Halpern & Regmi, 2013). We formed the categories beforehand but were open for new findings. By doing so, we for example recognized how some explicitly advertise with fast internet connections. The initial categories and resulting typology can be found in table 2. The categories, mainly the target group(s), service(s) and further description, provided us with sufficient information to determine the type of hub. Thereby, the types identified by the literature review beforehand were applied, sometimes several typologies fitted one hub. This analysis provided a temporary picture of these initiatives since websites and the offers themselves can change quickly (Fielding, Lee, & Blank, 2016), but it gave us a first indication how rural digital hubs can be further classified. By using this approach together with the survey, we got both, a rather global overview of what may be 'out there' and region-specific views by asking follow-up questions about contextual factors.

Table 2. *Content Analysis Categories and Typologies*

Categories initial content analysis	Resulting in the following determining typologies
Name hub	Typology hub
Country	Typology organisation–provider
Service(s)	Typology services (combination or not)
Scope (setup)	Typology target group
Target group(s)	
Provider(s)	
Further description	

3.2 *Survey Responses*

The majority of digital hub contacts sampled were from England, Germany, the Netherlands, and Spain. Each contact received an email with a survey invitation twice within two months (June and August 2018). Sending out the survey resulted in getting more information from 14 rural digital hub cases. We assume that the low response rate relates to the fact that these places may not perceive themselves necessarily as a rural digital hub, or at least not in the first instance when combined with other offers. However, it was not our aim to receive as many responses as possible but rather to gain additional information by exploring a few cases of rural digital hubs.

4.0 **Results**

4.1 *Content Analysis*

Based on the website content analysis, we found that most of the hubs targeted businesses only (N=89) and 23 were focused on the community members. Forty-five hubs indicated to be open for both businesses and the community as a whole. Differentiated based on our classification (see Figure 1), most hubs also fitted best into the enterprise hub category (N=72). The few hub types not displayed in Figure 1 (labelled as ‘other’) are listed in Table 3. We furthermore found 18 fab labs targeting rural areas and 16 training hubs. The other hubs can be mainly described as a mixture of the categories, for example, enterprise and innovation hubs (N=7), enterprise and fab lab (N=7) and so on. Remarkable here is that only a few fitted in the PIAP category. Further, plain innovation hubs tend to be rare in rural areas. A few hubs were combined with community centres, for this we also listed them separately.

Figure 1. Main Hub Types in Numbers.

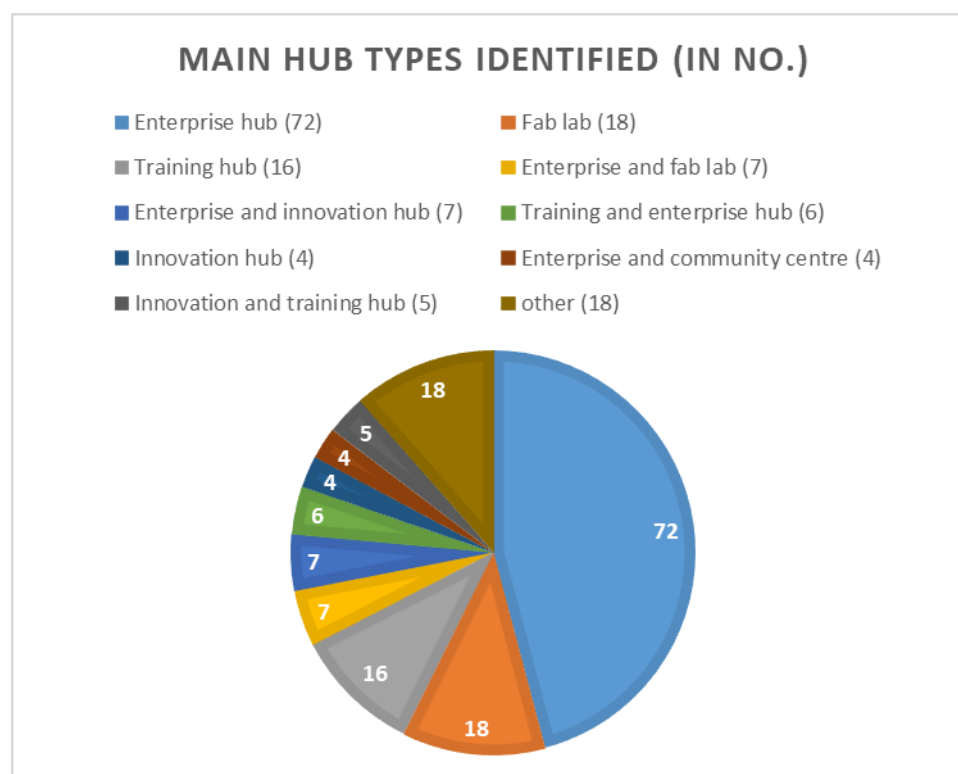


Table 3. *Other Hub Types Found*

Other hub types	Quantity
PIAP, training and community centre	3
Training, innovation, and enterprise hub	3
Innovation and training hub, fab lab	2
PIAP and community centre	2
Innovation and fab lab	2
PIAP	2
PIAP and training hub	1
Farm offering an enterprise hub	1
Fab lab and training hub	1
Training and enterprise hub, fab lab	1

Often, based on the website content, it was unclear who the provider of the hub was, as such we do not present any findings here, but the ones who did indicate it were either organized by private stakeholders, public stakeholders, NGOs, or even by a combination of partners.

Of interest is that 33 hubs explicitly advertised (fast) broadband or WIFI accessibility in the hub. Furthermore, the majority of the hubs offered a range of services or were integrated into places with other functions. These we labelled as combination hubs (N=132), while 22 can be described as plain hubs, which means these focused on one main service. A few (N=3) did not completely clarify the types of service. To illustrate what we mean with offering several services, we introduce some reoccurring practices below.

Some hubs were not only co-working but even co-living spaces, primarily targeting freelancers or digital nomads and mostly also advertising the location of the hub. Two hubs, for instance, were close by surfing locations. Further, some hubs had offers such as a swimming pool, gym, or leisure activities. Co-living hubs furthermore offered accommodation and often food.

Many of the hubs—at least when these largely targeted the community—were not standing alone, but were integrated into community centres, libraries, or similar. For instance, we identified a hub which is already called a community web hub. This one offered free courses on ICT and employability and targeted especially people who were currently unemployed and looking for work, or who were thinking of returning to work after an illness. It was based within the lifelong learning centre together with a library. Another hub we identified was directly based in two local libraries. There, ICT courses were offered and drop-in for help was possible. Furthermore, this initiative offered workshops at home if wanted, since it primarily targeted the elderly. One community centre run by a charity simply offered—besides its other community activities—a free to use IT suite, meaning a PIAP was in place.

Further, we found out that a large share of the hubs offered events, workshops, mentoring or similar activities. One hub for instance, which was already a mixture of fab lab and enterprise hub, had additionally hack workshops and a repair café available. Another digital hub classified as innovation and training hub had also an XR (extended reality) cyberspace, especially for events and workshops.

4.2 Survey

Fourteen people responded to our rural digital hub survey, thus resulting in fourteen cases with additional information besides the content analysis. The participants were from 10 European countries: two from Ireland, England and Spain, and one each from France, Serbia, Belgium, Scotland, Portugal, Denmark, Germany, and the Netherlands. All of them targeted areas which were 80 to 100 percent rural, with only one targeting a location considered to be around 30 percent rural. One of the participants did not answer all of the questions, for example, about the challenges the hub faces. This was probably because this hub was still in the planning phase. Five of the hubs completing our survey were enterprise hubs. Three were training hubs and two can be identified as fab labs. Furthermore, two were innovation and training hubs and two fit in other several categories. Although we had only a small number of participants, there was substantial variation among them.

Many named one or several challenges their region was facing. Most often this was youth outmigration or insufficient economic development. One survey participant listed the challenges they faced and specifically mentioned the problem of citizens being digital by default: “Closure of banks. Government Digital by Default. Expectations precede infrastructure “ (A).

Generally, the challenges the area was facing corresponded with the target user groups of the hubs. For example, one participant identified several challenges which were related to the economic situation. The target group of this specific

hub were businesses. To determine whether there was another support offered for digital literacy training or similar at place, we also asked about such initiatives. Only two were reported: young people involved in a ‘kind of digital business’ and the library.

In general, the participating hubs were at different stages of development, with some just starting or even still in the planning phase, while others had been in operation for more than four years. The hubs were initiated by the following stakeholders, sometimes several were involved: (a) local authorities, (b) private corporations, (c) citizens, (d) the EU, (e) the regional authority, (f) a university or (g) a charity. Most of the hub cases aim at the improvement of digital literacy rather than the improvement of access, and most required the users to pay. A few survey participants had an issue with the hub not being used by all of the community members it targeted, meaning that the hub had a lower than expected usage rate. A larger problem, however, was the limited financial resources available for the hubs. One survey participant even reported the previous failure of a hub due to this issue. We asked how the hubs tried to overcome these challenges, and one quote makes very clear that diversification was applied as a possible strategy: “We diversified the scope of our activities. As an example we created an international residency program, complementary to the fablab, enabling I. to generate an interesting amount of own revenues” (I). A general overview of the hubs’ foci, services and the problems faced by the respective regions is also provided in the following subsections.

4.2.1 Training Hub. Three of the hubs fit the description of a training hub (See table 4). Two were located in rural areas in the UK (one in Scotland) and indicated that these target community members gaining digital literacy skills: “we aim to support people in gaining digital & online skills and employability support” (B). Both of them focused especially on challenged groups, such as the elderly, the isolated, and the unemployed. One training hub located in Spain targeted both, community members and businesses. Its central aim was to be “a place for training and empowering the rural population in entrepreneurship and digital skills” (C). Next to technology demonstrations and events, ICT training was offered for businesses. Two operated without charging (B and C), and one charged for offered services (A). Hub A and C were privately organized, while B was operated by a charity. Each of the hubs faced one or more regional challenges. Moreover, hub B evaluated its influence on community resilience with ‘substantial’ and hub C chose ‘very much’, while hub A went for ‘slightly’.

Table 4. *Overview of Training Hubs*

NUTS3 Region in which rural digital hub is located	Identifier
Calderdale, England	A
Dumfries and Galloway, Scotland	B
Huelva, Spain	C

4.2.2 Enterprise Hub. Overall, five enterprise hubs responded to the survey (see Table 5). Interestingly, three of the enterprise hubs targeted both, businesses and community members, while two only targeted businesses. The central aim of two enterprise hubs—based in Ireland and Serbia—was to be a workplace and foster creativity. Another Irish hub put offering broadband central, to “provide access to broadband connectivity with the complementing facilities and technical set up...[targeting] all catchment areas around the towns where

broadband is not available” (F), and a French hub mentioned providing fast internet for work as well as being a place for remote workers. One hub located in Spain described itself as a business incubator. Two hubs additionally stressed to be a place to meet or to collaborate. All enterprise hubs charged for the use of the hub. Interesting though, is their ownership: two were operated privately (hub G and H), hub D and F were offered by the local authority and one of the hubs (E) was operated by citizens and privately initiated by citizens. Almost all of the enterprise hubs indicated one to several regional challenges. When being asked for the services offered, all of them named several such as meeting places, offices to rent and events, as H states:

It's a property with five objects ... (one) object has private rooms that are for one or two people on the second floor, while on the 1st is a library with a billiard room. Library can be used for meetings, Skype calls, etc. Also... where our kitchen is located. (One) is equipped with offices for the staff on the 1st floor, on the 2nd there are two rooms with another conference space. (One) object is a restaurant and a bar... it can be used for different occasions—from conferences, parties etc. (One) object is used only for work. 2nd floor is for co-working space (and) has two conference spaces... From there one can go on the big terrace. (One) space is (with) hostel like dorm rooms... there are as well other facilities such as swimming pool and a gym (H).

Hubs D and H rated their overall contribution to community resilience with ‘substantially’, hub E and F with ‘medium’, while G went for slight influence.

Table 5. *Overview Enterprise Hubs*

NUTS3 Region in which rural digital hub is located	Identifier
Girona, Spain	D
Haute-Savoie, France	E
Mid-West Region, Ireland	F
Border region, Ireland	G
North Banat District, Serbia	H

4.2.3 Fab Lab. Two survey participants can be classified as *fab labs*, one based in Portugal and one in Belgium (see Table 6). These targeted both businesses and community members and named additionally pupils or new residents. “All people who want to use our Labmachines (kids, students, adults,...) Mostly people from J. area but everyone is welcome” (J). Looking at their central aims, both aimed at boosting innovation or the start-up-rate, one also mentioned education. Hub I indicated that they charged for usage while hub J explained that they only charged for commercial usage. Furthermore, several parties were involved in the fab labs: Hub I was operated and initiated by citizens and private

sector, and J was initiated by public authorities, the EU and the university, while the operation was then taken over by the university only. The hub in Portugal listed several regional challenges, while the one in Belgium specified that meeting places were lacking in the region. Both offered several services, such as ICT training for citizens, events, and general assistance. With respect to community resilience, the Portuguese hub judged its influence as ‘very much’, while the Belgian hub went for slight influence.

Table 6. *Overview Fab Labs*

NUTS3 Region in which rural digital hub is located	Identifier
County Aljustrel, Portugal	I
Leuven, Belgium	J

4.2.4 Innovation and Training Hubs. Among our survey participants, we identified two innovation and training hubs: one located in England, aiming at businesses and the other in the Netherlands (see Table 7). The central aim of hub K was not stated, but several services were offered in this hub, for example, ICT training for businesses and technology demonstrations. It indicated that it does not charge for its usage and was organized by the local authority and by the private sector. Hub L aimed at businesses and schools, their target was “to stimulate economic growth and employment in L” (L). Services offered were for example, ICT training for businesses and citizens, offices to rent, and events. It indicated that it charges for its usage and was operated privately.

For the region of hub K, several challenges such as high unemployment or youth outmigration were named. With respect to community resilience, this hub evaluated its influence on community resilience as being large (‘very much’). The region where hub L is located seems to struggle as well, for example, with youth outmigration and low economic development. The influence of the hub on overall community resilience was evaluated as substantial.

Table 7. *Overview Innovation and Training Hub*

NUTS3 Region in which rural digital hub is located	Identifier
Lincolnshire, England	K
Oost-Groningen, Netherlands	L

4.2.5 Enterprise and Innovation Hub. One of the hubs located in Germany can be classified as a combination of enterprise and innovation hub (see Table 8). It was targeting businesses and aimed at supporting SMEs in digitisation. Services mentioned are for example, offices to rent and hardware and technology demonstrations. It charges for its usage and was initiated by the federal state authority, while operated privately. A challenge the region had to deal with was, according to the survey participant, youth outmigration. In terms of community resilience, this hub did not answer this question. We think this is because it was still in planning.

Table 8. *Overview Enterprise and Innovation Hub*

NUTS3 Region in which rural digital hub is located	Identifier
Heilbronn (county), Germany	M

4.2.6 Enterprise and Training Hub. One enterprise and training hub based in Denmark aimed at both community members and businesses (see Table 9). One should note here that the survey was filled in once for two different hubs. The training hub was in the form of a bus, the hubs were just both located in the same region. The central aim of the hubs was improving digital skills; services offered were for example, offices to rent and technology demonstrations. “The bus is for example adapted as follows: The bus is expected to be used as a mobile office, meeting room, wi-Fi-hub, training centre and mobile billboard” (N). It charges for the usage and was initiated by the local authority while operated also privately. Further, this survey participant named several challenges faced in the region and ranked the influence on overall community resilience as being substantial.

Table 9. *Overview Enterprise and Training Hub*

NUTS3 region in which rural digital hub is located	Identifier
Province Ostjylland, Denmark	N

5.0 Discussion

5.1 High Hopes and a Critical Evaluation of the Definition

In the context of a new rural policy orientation (Pezzini, 2001), new public management and finance issues, especially in declining rural areas (Raugze et al., 2017), one can expect local authorities looking for opportunities to attain their objectives with comparatively low costs. This may also be the case for digital infrastructure and skills. As the results showed, almost all our survey cases were located in regions facing several challenges. This may be an initial indication that rural digital hubs are considered by public and private stakeholders to be part of solving the problems of underperforming areas. This might lead to high hopes in terms of the delivery of these initiatives. Further, one can assume private initiatives responding to the lack of public services in rural settings. It has been recommended to further set up rural enterprise hubs, as these can serve as a meeting point, contribute to innovation, and offer needed office space (Merrell, 2019). Still, one can argue that it is crucial for this kind of place that the right people are involved or even available. Just setting up a physical space is insufficient, the people organizing it are key to making it successful, mainly by being able to form successful networks inside and outside the hub (Katonáné Kovács & Zoltán, 2017). For example, Berger and Brem (2016) noted the success of an innovation hub depends very much on the people and innovations can take some time (Berger & Brem, 2016). Therefore, we argue that it is very place dependent on whether or what kind of hub could be set up, as was also concluded by Ashmore and Price (2019). This reflects the argument to be careful with making high-tech development the main solution without considering spatial circumstances and paying attention to local understanding of technology (Golding & Brannon, 2020).

Further, we think that the definition of rural digital hubs to date includes places not necessarily proactively aiming at promoting digital literacy or recognising themselves in the first instance as a rural digital hub. Just because a place offers digital equipment and infrastructure in a rural setting does not necessarily make it a digital hub. To date, the definition allows various types of spaces to be counted as a rural digital hub. However, many public and third places have nowadays some kind of internet connectivity or ICT equipment available. As such, we suggest narrowing the definition down: only when a hub specifically targets businesses or community members to either improve their digital literacy or make use of better internet connectivity should one speak of a rural digital hub. This would still include many hubs we had a closer look at in this study, but for example, exclude enterprise hubs with no such intentions. We furthermore argue that to be able to speak of a hub it should exist for a longer period, meaning temporary training offers are excluded. It was suggested that there is a range of digital training programmes, including mobile services or schooling in hamlets and farmyards in various countries (Warren, 2007). This is also why we excluded temporary offers when selecting the hub contacts for this study.

It is interesting to see how digital hubs apparently adapt over time. While in the past, often PIAPs have been reported in the literature (see chapter 2.1.2), we have found little of that type. One needs to note here though that we excluded Wi-Fi offers only from the rural digital hub definition. Jaeger, Bertot, Thompson, Katz, and Deoster (2012) showed that public libraries are important public spaces offering internet access, but also computers and sometimes IT instruction possibilities. Yet, a study in the US suggested that rural public libraries are often under pressure in terms of financial resources and personnel and can therefore not always offer as much support—courses and so forth—as they wish (Real, Bertot, & Jaeger, 2014). We did not systematically search for all rural libraries as that would go beyond the scope of this research, but we certainly acknowledge the important role a library can play addressing digital divides. As shown, some of the rural digital hubs identified in our study were linked to libraries. However, we claim that with digital development progressing, many people nowadays have devices and internet access available, even if these may not be timely. That makes PIAPs, besides the ones in libraries, gradually redundant in areas with adequate broadband infrastructure. Probably the pace of digital development can also be a challenge for equipped digital hubs in general: permanently in need of upgrading their equipment and infrastructure to stay attractive for their visitors.

5.2 Accessibility Issues

In particular, people with low education levels or with low incomes—likewise older, retired, or inactive persons—tend to make less use of the internet. Furthermore, 43% of the entire EU population was revealed to have a lack of digital literacy. The main reasons for this include insufficient interest or necessity, lack of skills, and the related costs of the infrastructure (European Commission, 2018). To reach these groups, a rural digital hub may not be the right or sufficient measure. Most of the rural digital hubs investigated in this study charged for usage, posing an initial barrier to accessibility. In a study by Devins, Darwlow, and Smith (2002), people running the highest risk of being digitally excluded did not make use of an ICT learning centre. This might also be due to the fact that one needed to pay for the courses offered. Moreover, limited rural transport opportunities may further lead to accessibility problems, along with hubs without disability-friendly equipment. Thus, not all structural inequalities can be overcome even if a hub is meant to be inclusive (Jiménez & Zheng, 2018). Furthermore, Devins et al. (2002) stressed the challenge for ICT learning centres to attract non-traditional learners.

Then, only one rural digital hub in our study appeared to be used for the provision of fast internet. However, many rural areas are still without highspeed internet connections (Ashmore, Farrington, & Skerratt, 2015; Salemink et al., 2017). As such, infrastructural inequalities and general accessibility limitations may lead to further disparities related to digital literacy. Authorities in rural regions often face the challenge of reaching all community members and providing the right digital literacy training opportunities (Rundel, Salemink, & Strijker 2018). With society becoming increasingly ‘digital by default’, people living in remote places should be guaranteed adequate opportunities to improve their digital literacy, especially when the European Union as a whole strives towards smart villages (Zavratnik et al., 2018). We argue that policymakers cannot count on solving the digital literacy gap and accessibility issues solely by setting up digital hubs. The success of a digital hub depends on the services, objectives, accessibility, and acceptance of the hub by the community. Training programmes aimed at particularly vulnerable groups—such as older adults or people with disabilities—might prove to be essential in achieving a digitally inclusive society also encompassing rural regions. Nevertheless, rural digital hubs can be crucial additional facilities for rural businesses and communities to get in contact with and learn more about digital development, thereby possibly contributing to community resilience as well.

6.0 Conclusions

6.1 Combining Offers and User Groups and Expected Community Contribution

Our study has displayed that rural digital hubs, based on the ENRD definition, can take a rich variety of forms in Europe. Some of these even fit several categories. The hubs may be public or private initiatives and may target community members, businesses, or both. Among the rural digital hubs studied we have found a tendency to be used for business activities rather than providing services to citizens. Such hubs may be received positively by rural businesses. A case study in the UK mentioned rural SMEs appreciating technology hubs since these offer direct contact with new technologies (Price, Shutt, & Sellick, 2018). Although we differentiate between innovation and enterprise hubs, the distinction is not always completely clear since enterprise hubs can also lead to innovation. One could claim, since still business orientated, innovation hubs are a specific form of enterprise hubs. We have found, however, that plain innovation hubs are rare in rural areas. This should be mainly due to a lack of demand for such kind of specialised hubs.

Furthermore, we have shown that libraries and other third places such as community centres are used to offer digital literacy programmes and courses in rural areas. We did, however, not include all of them, only the ones providing regular offers. From our findings, we can conclude that a rural digital hub in place often targets businesses in rural areas or would at least like to stimulate business activities. There are also digital literacy initiatives for citizens, but we argue that it is difficult to maintain a digital hub in a rural area for a longer period for citizens only. We doubt that the flow of people and sufficient demand will persist. Rather, temporary initiatives come in place or are integrated into already existing structures such as libraries or community centres. This highlights the opportunity to use already existing ‘hubs’ in rural areas to integrate for example, digital literacy courses. It was already argued in relation to urban co-working spaces that digital hubs must meet a certain usage threshold to become viable in the long term (Waters-Lynch & Potts, 2017). It is advisable to have one centre that serves multiple purposes, as Fuzi (2015) noted for co-working spaces in

small cities. Indeed, our cases show a tendency to integrate several functions and services into one hub. This reflects the rural digital hub definition provided by the ENRD (2017) and used in this research. We suggest that this is a response to the sparse population density: by aiming to satisfy various needs, potentially more customers are attracted, probably creating additional value for other rural digital hub users. Whether this always works and whether various user groups harmonize is a question we cannot answer at this point.

Consequently, we give the following policy recommendations:

- A rural digital hub for citizens ideally uses co-location with other services to safeguard a sufficient user-threshold.
- It should be a place for the rural community to get into contact with digital developments and to receive assistance, for example with various e-government tools.
- If set up for both, citizens and businesses or businesses only, the hub ought not to be too specialised, yet fitting the regional and local needs.
- Moreover, a digital hub should meet accessibility standards, yet it should not be made the only solution to reach out to rural communities in order to foster digital literacy and broadband adoption.

Looking at the responses regarding the influence on community resilience, it seems that these depend on the hub type, but even then, the ratings are to an extent dissimilar. This lets us assume varied expectations based on their setup, experiences, and regional factors probably play an important role, for example, which facilities are already available. This is a relevant finding, revealing that the hubs could to an extent contribute, but that it depends very much on the hub setup. The expectation that the hubs can contribute to overall community resilience within their target area accords with the assumption that initiators have partly high expectations related to their hubs, exceeding the sole function of improving internet access and digital literacy. As discussed in chapter 5.1, this fits the picture that almost all listed several regional challenges such as lagging economic development or youth outmigration. However, one also needs to keep in mind that some communities need more support from the state to develop resilient communities by implementing and conducting such projects than others (Markantoni, Steiner, & Meador, 2019).

6.2 Further Research

The hub categories we have used in this study are based on the information the hubs provided. However, one must note the possibility that some important information was not to be found online or was not mentioned in the survey. Further, we do not claim to provide a complete representative overview for all European countries in this study, but rather first insights into what can be ‘out there’ and how these hubs can be characterized. It could, therefore, be that we missed out rural digital hub forms or designs.

The conceptualization and empirics in this paper suggest that rural digital hubs can contribute to community resilience, however, more in-depth case study research would be needed to better understand the interconnections of the hubs with people and places. For our outcomes related to accessibility, it would be worthwhile to determine what other digital literacy training opportunities are available in the rural context and to what degree these are equally accessible to rural residents and entrepreneurs. On this basis, we could determine whether there are sufficient opportunities.

Acknowledgement

This research would not have been possible without the financial support of the EU Interreg VB North Sea Region Programme.

References

- Apostolopoulos, N., Newbery, R., & Gkartzios, M. (2019). Social enterprise and community resilience: Examining a Greek response to turbulent times. *Journal of Rural Studies*, 70, 215–224. <https://doi.org/10.1016/j.jrurstud.2018.03.017>
- Arifoglu, A., Afacan, G., & Er, E. (2013). An analysis of public internet access points (PIAPs). *Journal of Community Informatics*, 9(1), 111–118.
- Arifoğlu, A., Afacan, G., & Er, E. (2011). Guidelines for successful public internet access points (PIAPs) implementation. In Management Association, I. (Ed.), *Digital Democracy: Concepts, Methodologies, Tools, and Applications* (pp. 370-389). IGI Global. <http://doi:10.4018/978-1-4666-1740-7.ch019>
- Ashmore, F. (2015, August). Interaction between digital policy and community-led broadband organisations in the UK: The loss and creation and loss of rural well-being. *Proceedings of the XXVI European Society for Rural Sociology Congress: Places of possibility? Rural societies in a neoliberal world*. Aberdeen, Scotland. <https://esrs2015.hutton.ac.uk/sites/www.esrs2015.eu/files/FINAL%20ESRS%20Congress%20Proceedings.pdf>
- Ashmore, F., & Price, L. (2019). CORA Digital Hub Guide. United Kingdom: Lincoln International Business School, University of Lincoln. <http://eprints.lincoln.ac.uk/id/eprint/39850/1/CORA%20Digital%20Hub%20Guide%2009.01.2019.pdf>
- Ashmore, F. H., Farrington, J. H., & Skerratt, S. (2015). Superfast broadband and rural community resilience: Examining the rural need for speed. *Scottish Geographical Journal*, 131(3–4), 265–278. <https://doi.org/10.1080/14702541.2014.978808>
- Berger, A., & Brem, A. (2016). Innovation hub how-to: Lessons from Silicon Valley. *Global Business and Organizational Excellence*, 35(5), 58–70. <https://doi.org/10.1002/joe.21698>
- Bowen, J. T. (2012). A spatial analysis of FedEx and UPS: Hubs, spokes, and network structure. *Journal of Transport Geography*, 24, 419–431. <https://doi.org/10.1016/j.jtrangeo.2012.04.017>
- Bryman, A., Becker, S., & Sempik, J. (2008). Quality criteria for quantitative, qualitative and mixed methods research: A view from social policy. *International Journal of Social Research Methodology*, 11(4), 261–276. <https://doi.org/10.1080/13645570701401644>
- Buksh, B., & Davidson, J. (2013). Digital work hubs: An activation framework for South East Queensland. Retrieved from <https://www.rdasunshinecoast.org.au/wp-content/uploads/2015/11/RDA-Digital-Work-Hub-Project-Final-Report-Dec-2013.pdf>

- Bürgin, R., & Mayer, H. (2020). Digital periphery? A community case study of digitalization efforts in Swiss mountain regions. In S. Patnaik, S. Sen, & M. S. Mahmoud (Eds.), *Smart village technology: Concepts and developments* (pp. 67–98). Cham, Switzerland: Springer. https://doi.org/10.1007/978-3-030-37794-6_4
- Capdevila, I. (2017). Typologies of localized spaces of collaborative innovation. In M. van Ham, D. Reuschke, R. Kleinhans, C. Mason, & S. Syrett (Eds.), *Entrepreneurial neighbourhoods: Towards an understanding of the economies of neighbourhoods and communities* (pp. 80–97). Cheltenham, United Kingdom: Edward Elgar.
- Clark, L. S. (2003). Challenges of social good in the world of Grand Theft Auto and Barbie: A case study of a community computer center for youth. *New Media and Society*, 5(1), 95–116. <https://doi.org/10.1177/1461444803005001909>
- Cowie, P., Thompson, N., & Rowe, F. (n.d.). Honey pots and hives: Maximising the potential of rural enterprise hubs. United Kingdom: Centre for Rural Economy, Newcastle University.
- Davoudi, S., Shaw, K., Haider, L. J., Quinlan, A. E., Peterson, G. D., Wilkinson...Davoudi, S. (2012). Resilience: A bridging concept or a dead end? *Planning Theory & Practice*, 13(2), 299–333. <https://doi.org/10.1080/14649357.2012.677124>
- Davoudi, S. (2018). Self-reliant resiliency and neoliberal mentality: A critical reflection. In E. -M. Trell, B. Restemeyer, M. M. Bakema, & B. van Hoven. (Eds.), *Governing for resilience in vulnerable places* (pp. 1–6). Abingdon, United Kingdom: Routledge.
- Derudder, B., Conventz, S., Thierstein, A., & Witlox, F. (2014). Introduction: Knowledge hubs: Infrastructure and the knowledge economy in city-regions. In S. Conventz, B. Derudder, A. Thierstein, & F. Witlox (Eds.), *Hub cities in the knowledge economy: Seaports, airports, brainports* (pp. 1–7). Farnham, United Kingdom: Ashgate.
- Devins, D., Darlow, A., & Smith, V. (2002). Lifelong learning and digital exclusion: Lessons from the evaluation of an ICT learning centre and an emerging research agenda. *Regional Studies*, 36(8), 941–945. <https://doi.org/10.1080/0034340022000012360>
- European Network for Rural Development [ENRD]. (2017a). *Case study: Rural digital hubs (working document): Revitalising rural areas through digitisation: The experience of three rural digital hubs*. Retrieved from https://enrd.ec.europa.eu/sites/enrd/files/tg_rural-businesses_case-study_rural-digital-hub.pdf
- European Network for Rural Development [ENRD]. (2017b). *Re-imagining rural business opportunities* (EU rural review No. 24). Retrieved from <https://enrd.ec.europa.eu/sites/enrd/files/publi-enrd-rr-24-2017-en.pdf>
- European Network for Rural Development [ENRD]. (2017c). *Workshop 1—Rural Digital Hubs. How to ensure that they successfully help rural businesses seize the opportunities of digitisation?* Retrieved from https://enrd.ec.europa.eu/sites/enrd/files/s4_rural-businesses-factsheet_digital-hubs.pdf

- European Commission. (2016a). *A new skills agenda for Europe: Working together to strengthen human capital, employability and competitiveness*. Retrieved from <https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-381-EN-F1-1.PDF>
- European Commission. (2016b, April 19). *Communication: Digitising European industry Reaping the full benefits of a Digital Single Market*. <https://ec.europa.eu/digital-single-market/en/news/communication-digitising-european-industry-reaping-full-benefits-digital-single-market>
- European Commission. (2017). *A common European response to shared goals*. https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=43900
- European Commission. (2018). *Human capital digital inclusion and skills*. http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=52247
- European Innovation Partnership ‘Agricultural Productivity and Sustainability’ [EIP-AGRI]. (2017, October). *Eip-Agri Seminar: Digital innovation hubs for agriculture* (final report). Retrieved from https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_seminar_digital_innovation_hubs_final_report_2017_en.pdf
- European Union Interreg North Sea Region. (n.d.). *Welcome to the CORA project (Connecting Remote Areas with digital infrastructure and services)*. Retrieved January 24, 2019, from <https://northsearegion.eu/cora/>
- Fidel, R. (2008). Are we there yet?: Mixed methods research in library and information science. *Library & Information Science Research*, 30(4), 265–272. <https://doi.org/10.1016/j.lisr.2008.04.001>
- Fielding, N. G., Lee, R. M., & Blank, G. (2016). The SAGE handbook of online research methods. <https://doi.org/10.4135/9781473957992>
- Folke, C. (2006). Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*, 16(3), 253–267. <https://doi.org/10.1016/j.gloenvcha.2006.04.002>
- Frennert, S., Efrting, H., & Östlund, B. (2013). What older people expect of robots: A mixed methods approach. In G. Hermann, M. J. Pearson, A. Lenz, P. Bremner, A. Piers, & U. Leonards (Eds.) *Social Robotics. ICSR 2013. Lecture notes in computer science* (vol. 8239). Cham, Switzerland, Springer. https://doi.org/10.1007/978-3-319-02675-6_3
- Fuzi, A. (2015). Co-working spaces for promoting entrepreneurship in sparse regions: The case of South Wales. *Regional Studies, Regional Science*, 2(1), 462–469. <https://doi.org/10.1080/21681376.2015.1072053>
- Glover, J. (2012). Rural resilience through continued learning and innovation. *Local Economy*, 27(4), 355–372. <https://doi.org/10.1177/0269094212437833>
- Golding, S. A., & Brannon, M. M. (2020). Science as snake oil: Rural development, discourse, and the broken promise of tech jobs in Vermont. *Rural Sociology*, 85(2), 408–435. <https://doi.org/10.1111/ruso.12294>
- Halpern, N., & Regmi, U. K. (2013). Content analysis of European airport websites. *Journal of Air Transport Management*, 26, 8–13. <https://doi.org/10.1016/j.jairtraman.2012.08.006>

- Hayden, C., & Ball-Rokeach, S. J. (2007). Maintaining the digital hub: Locating the community technology center in a communication infrastructure. *New Media & Society*, 9(2), 235–257. <https://doi.org/10.1177/1461444807075002>
- Hjorthol, R., & Gripsrud, M. (2009). Home as a communication hub: The domestic use of ICT. *Journal of Transport Geography*, 17(2), 115–123. <https://doi.org/10.1016/j.jtrangeo.2008.11.007>
- Huggins, R., & Izushi, H. (2002). The digital divide and ICT learning in rural communities: Examples of good practice service delivery. *Local Economy: The Journal of the Local Economy Policy Unit*, 17(2), 111–122. <https://doi.org/10.1080/02690940210129870>
- Institute of European Telecommunications Standards. (2008). *ETSI TS 102 577 Human Factors (HF); Public Internet Access Points (PIAPS)*. Retrieved from https://www.etsi.org/deliver/etsi_ts/102500_102599/102577/01.01.01_60/ts_102577v010101p.pdf
- Jaeger, P. T., Bertot, J. C., Thompson, K. M., Katz, S. M., & Decoster, E. J. (2012). The intersection of public policy and public access: Digital divides, digital literacy, digital inclusion, and public libraries. *Public Library Quarterly*, 31(1), 1–20. <https://doi.org/10.1080/01616846.2012.654728>
- Jiménez, A., & Zheng, Y. (2018). Tech hubs, innovation and development. *Information Technology for Development*, 24(1), 95–118. <https://doi.org/10.1080/02681102.2017.1335282>
- Kaplan, S., & Sawhney, M. (2000). E-hubs: the new B2B marketplaces. *Harvard Business Review*, 78(3), 97–103.
- Katonáné Kovács, J., & Zoltán, E. S. (2017). Rural enterprise hub supporting rural entrepreneurship and innovation-Case studies from Hungary. *European Countryside*, 9(3), 473–485. <https://doi.org/10.1515/euco-2017-0028>
- Kim, I., & Kuljis, J. (2010). Applying content analysis to web-based content. *Journal of Computing and Information Technology*, 18(4). <https://doi.org/10.2498/cit.1001924>
- Kojo, I., & Nenonen, S. (2016). Typologies for co-working spaces in Finland—What and how? *Facilities*, 34(5/6), 302–313. <https://doi.org/10.1108/F-08-2014-0066>
- Lægran, A. S. (2002). The petrol station and the Internet café: Rural technospaces for youth. *Journal of Rural Studies*, 18(2), 157–168. [https://doi.org/10.1016/S0743-0167\(01\)00036-5](https://doi.org/10.1016/S0743-0167(01)00036-5)
- Lameijer, C. S., Mueller, B., & Hage, E. (2017). Towards rethinking the digital divide—Recognizing shades of grey in older adults’ digital inclusion. Paper presented at 38th International Conference on Information Systems [ICIS], Seoul, Republic of Korea.
- London, R. A., Pastor, M., Jr., Servon, L. J., Rosner, R., & Wallace, A. (2010). The role of community technology centers in promoting youth development. *Youth & Society*, 42(2), 199–228. <https://doi.org/10.1177/0044118X09351278>
- Markantoni, M., Steiner, A. A., & Meador, J. E. (2019). Can community interventions change resilience? Fostering perceptions of individual and community resilience in rural places. *Community Development*, 50(2), 238–255. <https://doi.org/10.1080/15575330.2018.1563555>

- McGuirk, P. M., & O'Neill, P. (2005). Using questionnaires in qualitative human geography. In I. Hay (Ed.), *Qualitative research methods in human geography* (pp. 246-273). Don Mills, Canada: Oxford University Press.
- McManus, P., Walmsley, J., Argent, N., Baum, S., Bourke, L., Martin, J.,...Sorensen, T. (2012). Rural community and rural resilience: What is important to farmers in keeping their country towns alive? *Journal of Rural Studies*, 28(1), 20–29. <https://doi.org/10.1016/j.jrurstud.2011.09.003>
- Merrell, I. (2019). *Rural business knowledge exchange and innovation: The contribution of rural enterprise hubs* (Unpublished doctoral dissertation). Newcastle University, Newcastle upon Tyne, United Kingdom.
- Neal, Z. P. (2014). Types of hub cities and their effects on urban creative economies. In S. Conventz, B. Derudder, A. Thierstein, F. Witlox (Eds.), *Hub cities in the knowledge economy: Seaports, airports, brainports* (pp. 203–221). London, United Kingdom: Routledge.
- Nygren, Å. (2014). The public library as a community hub for connected learning. Paper presented at: IFLA WLIC 2014 - Lyon - Libraries, Citizens, Societies: Confluence for Knowledge in Session 167 - Management and Marketing with Public Libraries. In: IFLA WLIC 2014, 16-22 August 2014, Lyon, France. (<http://library.ifla.org/1014/>)
- Pettit, S. J., & Beresford, A. K. C. (2009). Port development: From gateways to logistics hubs. *Maritime Policy & Management*, 36(3), 253–267. <https://doi.org/10.1080/03088830902861144>
- Pezzini, M. (2001). Rural policy lessons from OECD countries. *International Regional Science Review*, 24(1), 134–145. <https://doi.org/10.1177/016001701761013024>
- Price, L., Shutt, J., & Sellick, J. (2018). Supporting rural Small and Medium-sized Enterprises to take up broadband-enabled technology: What works? *Local Economy*, 33(5), 515–536. <https://doi.org/10.1177/0269094218791508>
- Ramirez, R. K. (2007). *Native hubs: Culture, community and belonging in Silicon Valley and beyond*. Durham, NC: Duke University Press.
- Raugze, I., Daly, G., & van Herwijnen, M. (Eds.) (2017). *Shrinking rural regions in Europe*. Retrieved from <https://www.espon.eu/sites/default/files/attachments/ESPON%20Policy%20Brief%20on%20Shrinking%20Rural%20Regions.pdf>
- Real, B., Bertot, J. C., & Jaeger, P. T. (2014). Rural public libraries and digital inclusion: Issues and challenges. *Information Technology and Libraries*, 33(1), 6–24. <https://doi.org/10.6017/ital.v33i1.5141>
- Roberts, E., Anderson, B. A., Skerratt, S., & Farrington, J. (2017). A review of the rural-digital policy agenda from a community resilience perspective. *Journal of Rural Studies*, 54, 372–385. <https://doi.org/10.1016/j.jrurstud.2016.03.001>
- Rundel, C., Salemink, K., & Strijker, D. (2018). CORA diagnostic survey results: Results and guiding measures. Retrieved from https://www.researchgate.net/publication/327623292_CORA_Diagnostic_Survey_Results_-_Results_and_Guiding_Measures

- Salemink, K., & Strijker, D. (2018). Digitaal Platteland - White paper over digitale ontsluiting van het Nederlandse platteland. Retrieved from https://www.researchgate.net/publication/322931466_Digitaal_Platteland_White_paper_over_digitaal_ontsluiting_van_het_Nederlandse_platteland
- Salemink, K., Strijker, D., & Bosworth, G. (2017). Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. *Journal of Rural Studies*, 54, 360–371. <https://doi.org/10.1016/j.jrurstud.2015.09.001>
- Skerratt, S., & Steiner, A. (2013). Working with communities-of-place: Complexities of empowerment. *Local Economy*, 28(3), 320–338. <https://doi.org/10.1177/0269094212474241>
- Stacey, M. (2014). The FAB LAB Network: A global platform for digital invention, education and entrepreneurship. *Innovations: Technology, Governance, Globalization*, 9(1–2), 221–238. <https://doi.org/10.1162/inov.a.00211>
- Steiner, A., & Atterton, J. (2014). The contribution of rural businesses to community resilience. *Local Economy*, 29(3), 228–244. <https://doi.org/10.1177/0269094214528853>
- Steiner, A., & Markantoni, M. (2014). Unpacking community resilience through Capacity for Change. *Community Development Journal*, 49(3), 407–425. <https://doi.org/10.1093/cdj/bst042>
- Terlouw, K., & Denkers, R. (2011). The geography of regional websites: Regional representation and regional structure. *Geoforum*, 42(5), 578–591. <https://doi.org/10.1016/j.geoforum.2011.05.003>
- Townsend, L., Sathiaselan, A., Fairhurst, G., & Wallace, C. (2013). Enhanced broadband access as a solution to the social and economic problems of the rural digital divide. *Local Economy*, 28(6), 580–595. <https://doi.org/10.1177/0269094213496974>
- Virani, T. (2015, April). *Re-articulating the creative hub concept as a model for business support in the local creative economy: The case of Mare Street in Hackney* (Creativeworks London working paper No, 12). Retrieved from <https://qmro.qmul.ac.uk/xmlui/bitstream/handle/123456789/7251/PWK%20Working%20Paper%2012.pdf?sequence=2&isAllowed=y>
- Warren, M. (2007). The digital vicious cycle: Links between social disadvantage and digital exclusion in rural areas. *Telecommunications Policy*, 31(6–7), 374–388. <https://doi.org/10.1016/j.telpol.2007.04.001>
- Waters-Lynch, J., & Potts, J. (2017). The social economy of co-working spaces: A focal point model of coordination. *Review of Social Economy*, 75(4), 417–433. <https://doi.org/10.1080/00346764.2016.1269938>
- Willis, K. (2017). Digital neighbourhoods: Hyperlocal village hubs in rural communities. *Architectural Design*, 87(1), 92–97. <https://doi.org/10.1002/ad.2137>
- Wilson, G. (2010). Multifunctional ‘quality’ and rural community resilience. *Transactions of the Institute of British Geographers*, 35(3), 364–381. <https://doi.org/10.1111/j.1475-5661.2010.00391.x>
- Zavratnik, V., Kos, A., & Duh, E. S. (2018). Smart villages: Comprehensive review of initiatives and practices. *Sustainability*, 10(7). <https://doi.org/10.3390/su10072559>

- Zwiers, S., Markantoni, M., & Strijker, D. (2016). The role of change- and stability-oriented place attachment in rural community resilience: A case study in south-west Scotland. *Community Development Journal*, 53(2). <https://doi.org/10.1093/cdj/bsw020>